

## REMARKS

This Amendment and the accompanying Request for Continued Examination are filed in response to the August 26, 2005 final Office action that was issued in connection with the above-identified patent application. Prior to entry of the present Amendment, claims 36-66 remained pending in the application. Pursuant to this Amendment, claims 36 and 56 have been amended. Applicants respectfully request reconsideration of the rejected claims under 37 C.F.R. § 1.111 and allowance of the pending claims.

Claims 36-66 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over certain references cited by the Examiner. Applicants respectfully traverse these rejections and have amended the independent claims for clarity.

### Claims 36, 38-40, 44 and 54.

Claims 36, 38-40, 44 and 54 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,401,052 to Baron et al. ("Baron") in view of U.S. Patent No. 5,741,547 to Akram et al. ("Akram") or U.S. Patent No. 6,074,487 to Yosioka et al. ("Yosioka").

Combining Baron with Akram or Yosioka does not establish a prima facie case of obviousness for the claims as amended. First, neither Akram or Yosioka is analogous art with regard to Baron or applicants' application. Second, one skilled in the art would not be motivated to combine Baron with Akram or Yosioka. Third, the proposed modification of Baron would render it unsatisfactory for its intended purpose. Fourth, the proposed modification of Baron changes its principle of operation.

It is worth noting from the outset that physical vapor deposition ("PVD") and chemical vapor deposition ("CVD") are markedly different deposition methods employed

for different purposes. As discussed in the Background of the specification beginning on page 1, a PVD method involves vaporizing a source material by physical means, transporting the vapor to a substrate, and depositing the source material itself on the substrate by condensation. In contrast, a CVD method involves introducing a mixture of reactive vapor phase materials to a substrate, reacting the reactive vapor-phase material at the substrate surface, depositing the reaction product on the substrate surface, and removing reaction byproducts and unreacted vapor-phase materials. As amended, claim 1 recites a PVD system, whereas Akram and Yosioka disclose CVD methods and apparatus.

The cited References Represent Non-Analogous Art

Neither Akram or Yosioka is analogous art with regard to applicants' claimed invention because they are not within the same field of endeavor and are not reasonably pertinent to the problems addressed.

First, Akram and Yosioka are not analogous to applicants' claimed invention because they disclose CVD methods and apparatus for manufacturing semiconductor and integrated circuits. Applicants' application relates to an entirely different field of endeavor, PVD systems for manufacturing solar cells. Solar cells require different properties than do semiconductor or integrated circuits to ensure solar conversion efficiency, such as a relatively smooth surface and a surface with a homogenous composition. Conversely, Akram touts its ability to provide a 50% greater surface roughness.

Second, disclosures relating to CVD methods and apparatus to manufacture integrated circuits or semiconductors are not reasonably pertinent to the problems addressed by this application, such as producing complex multi-element solar cell films using currently available PVD sputtering or evaporation techniques. One problem addressed by this application is how to overlap plumes of different source material vapors to control source material compositions at different points of a substrate. Low pressure is used to achieve the compositions desired because it allows the plumes to mix freely; however, CVD methods operate at high pressures to ensure that the reactive gases arrive at the substrate simultaneously. One skilled in the art would know that the high pressures used by CVD methods inhibit the mixing achieved in applicants' PVD system.

Accordingly, Akram and Yoshioka are non-analogous art with regard to Baron and applicants' claimed invention.

#### No Motivation to Combine the References

One skilled in the art would not be motivated to combine Baron with Akram or Yoshioka because of the numerous incompatibilities between PVD and CVD methods.

First, one skilled in the art would not be motivated to combine the references because CVD methods impart properties onto a substrate that are undesirable for a solar cell. Baron discloses a PVD apparatus for manufacturing thin film solar cells whereas Akram and Yoshioka disclose CVD methods and apparatus for manufacturing semiconductor and integrated circuits. The disclosed CVD methods increase the coating surface roughness, which is detrimental to solar conversion efficiency.

Moreover, CVD methods cause compositional inhomogeneities that act as electronic defects, which further degrades solar cell performance.

Second, one skilled in the art would not be motivated to combine the references because PVD and CVD methods operate at significantly different pressures. CVD methods require substantially higher pressures than PVD methods to ensure the reactive gases have sufficient residence time on the substrate for heating and reaction. On the other hand, PVD methods operate at lower pressures to facilitate directional emission and a long mean-free-path between molecular collisions. Thus, CVD methods typically require pressures greater than  $10^{-3}$  Torr whereas PVD methods typically operate below  $10^{-4}$  Torr.

Third, one skilled in the art would not be motivated to combine the references because CVD methods don't deposit the source material itself, but rather deposit a reaction product. As discussed above, PVD methods deposit the actual source materials previously vaporized, whereas CVD methods react source materials to form reaction products and it is the reaction products that are deposited, not the source materials. The different deposition schemes would dissuade one skilled in the art from combining Baron, disclosing a PVD apparatus, with either Akram, disclosing a CVD apparatus, or Yoshioka, disclosing a CVD method.

Fourth, one skilled in the art would not be motivated to combine Baron with Yoshioka because the ultrasonic sprayer in Yoshioka is incompatible with the Baron operating temperatures. Baron teaches a PVD apparatus that operates at temperatures sufficient to evaporate a source material, such as cadmium sulfide in the example it provides. Yoshioka teaches the use of an ultrasonic sprayer to assist in vaporizing the

material. Piezoelectric materials are required for ultrasonic sprayers. No known materials are capable of piezoelectric operation above the melting point of cadmium sulfide or other metal source materials such as copper, gallium, or indium.

Modifying Baron as proposed would render it unsatisfactory for its intended purpose.

First, Baron intends to provide a reserve of source material to avoid process downtime from breaking vacuum to replenish chamber 10 when it runs out of source material. Baron accomplishes this goal of "an apparatus for continuous deposition" by providing a back-up chamber 11 containing the same source material. Modifying Baron to include a different material in chamber 11 than included in chamber 10 would defeat its intended purpose because the process would have to stop and break vacuum to replenish the chambers when either chamber 10 or 11 ran empty. Thus, Baron would become a batch process instead of a continuous process as intended.

Second, Baron intends to provide an apparatus that operates in a manner that is not complicated or expensive. In fact, Baron states that "control of evaporation rate from a multiplicity of crucibles by maintaining the temperatures of each crucible is difficult and costly." However, the proposed modification would require that Baron include different source materials in chambers 10 and 11. Thus, to operate the Baron apparatus as modified, one would have to control the evaporation rate from multiple crucibles, chambers 10 and 11, by maintaining them at different temperatures. Accordingly, operating Baron in this manner would run contrary to Baron's intended purpose of simple and cost effective operation.

Modifying Baron as Proposed Changes its Principle of Operation.

The proposed modification of Baron changes its principle of operation from a continuous processing apparatus to a batch processing apparatus, directly contrary to Baron's stated purpose. Baron operates by evaporating a single source material from a single heated chamber 10 into a deposition zone through an open valve 20. An initially unheated chamber 11 containing the same source material serves as a back-up and is isolated from the deposition zone by closed valve 21. Only upon exhaustion of the source material from chamber 10 is back-up chamber 11 heated to evaporate that same source material and is valve 21 opened. The proposed modification would require that Baron concurrently heat both chambers 10 and 11 and keep both valves 20 and 21 concurrently open. Operating in this manner, Baron would no longer have backup chambers of source material, which in effect would transform the Baron process back to a batch process contrary to its continuous process principle of operation.

Combining the References does not Disclose Each Element of the Claim

Combination of Akram or Yoshioka with Baron does not disclose each element of amended claim 36.

Combining the references does not disclose a PVD system with a fog having varying composition across the length of the physical vapor deposition zone as recited in claim 36. The Examiner asserts that Baron could be modified in view of Akram or Yoshioka to have different source materials in chamber 10 and chamber 11, but this modification would not produce a fog with varied composition across its length. The outlet pipes from chambers 10 and 11 join together prior to orifice 22; thus, in the proposed modification the source materials would mix prior to entering the coating

chamber 29. Prior mixing of the source material vapors results in a fog inside coating chamber 29 having a uniform composition. Accordingly, the fog would not have a composition that varied about the length of the deposition zone as recited in claim 36.

Moreover, neither Akram or Yoshioka teach a fog of varying composition along a processing length because both disclosures involve prior mixing of reactive gasses prior to entry into their reaction chambers. As is typical for CVD methods, Akram discloses a method wherein the reactant gases mix prior to exiting a shower head 15 and passing into the reaction zone. Further, in Fig. 11, Yoshioka discloses a mixer 11 for mixing vapor materials A, B, C, and D prior to their entry to deposition zone 1.

Combining the references does not disclose a system wherein different source materials are deposited onto a strip material in a physical vapor deposition zone. While Baron discloses depositing a single source material, neither combination of Baron with Akram or Yoshioka discloses depositing another *source material*. Instead, adding Akram or Yoshioka would result in the deposition of a *reaction product* onto a strip material. Because a reaction product is not a source material as recited in claim 36, combining the references does not disclose this feature.

For at least the aforementioned reasons, combining Baron with Akram or Yoshioka does not disclose each element of amended claim 36.

The above discussion demonstrates that combining Baron with Akram or Yoshioka does not establish that claim 36 is *prima facie* obvious under 35 U.S.C. § 103(a). Accordingly, combining the references does not render amended claim 36 or claims 38-40, 44 and 54 depending from claim 36 unpatentable under 35 U.S.C. § 103(a).

### **Claims 37, 47-53, and 55**

Claims 37, 47-53, and 55 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Baron in view of Akram or Yoshioka and in further view of U.S. Patent No. 5, 031,229 to Chow (“Chow”).

As established in the preceding section, combining Baron with Akram or Yoshioka does not establish that claim 36 is *prima facie* obvious. Claims 37, 47-53, and 55 depend from claim 36. Further combining the cited references with Chow does not change this conclusion because the heating system disclosed in Chow does not reconcile the missing elements and incompatibilities discussed above. Accordingly, claims 37, 47-53, and 55 depending from claim 36 are not rendered unpatentable under 35 U.S.C. § 103(a) in view of the cited references.

### **Claims 37, 47-53, and 55**

Claims 41-43, 45 and 46 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Baron in view of Akram or Yoshioka and Chow in further view of U.S. Patent No. 5,158,750 to Finicle (“Finicle”).

As established in the preceding section, combining Baron with Akram or Yoshioka does not establish that claim 36 is *prima facie* obvious. Claims 41-43, 45 and 46 depend from claim 36. Further combining the cited references with Finicle does not change this conclusion because the insulated crucible disclosed in Finicle does not reconcile the missing elements and incompatibilities discussed above. Accordingly, claims 41-43, 45 and 46 depending from claim 36 are not rendered unpatentable under 35 U.S.C. § 103(a) in view of the cited references.

**Claims 56-66.**

Claims 56-66 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Baron in view of Akram or Yoshioka and Chow in further view of U.S. Patent No. 5,571,749 to Matsuda et al. (“Matsuda”).

For reasons analogous to those previously presented regarding claim 36, combining Baron, Akram or Yoshioka, Chow, and Matsuda does not establish a prima facie case for obviousness of claim 56. CVD references Akram and Yoshioka are no more analogous to the claim 56 PVD system than they were to the claim 36 PVD system. Similarly, one skilled in the art would have no more motivation to combine CVD references with the claim 56 PVD system than one would have with claim 36. The additional combination of Matsuda, showing a CVD method with a roll assembly, does not reconcile the missing elements and incompatibilities present in the underlying combination of Baron with Akram or Yoshioka with regard to claim 56.

Accordingly, combining Baron, Akram or Yoshioka, Chow, and Matsuda does not establish a prima facie case that claim 56 is obvious under 35 U.S.C. § 103(a). It then follows that claims 57-66 depending from claim 56 are similarly not obvious. Applicants therefore request allowance of claims 56-66.

## II. Conclusion

Applicants have responded to all of the issues raised in the Office action. If there are any questions regarding this paper, or the application as a whole, the Examiner is encouraged to contact the undersigned attorney so that allowance of the claims may be facilitated.

### CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on December 22, 2005.

  
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Respectfully submitted,

  
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